

Location of Potassium-Fixing Soils in the San Joaquin Valley and a New, Practical Soil K Test Procedure

FREP Contract # 00-0508

Project Leaders:

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Objectives:

1. Produce a map of the San Joaquin Valley displaying soils used for cotton production with a high K-fixation capacity by overlaying in a geographic information system (GIS) the USDA database soils information onto locations of all cotton production fields in the SJV.
2. Determine how well laboratory measurements of K fixation agree with estimated potential K fixation based on soil mineralogy as described in the USDA soils database, as well as mineralogy determined by x-ray diffraction in the laboratory.
3. Compare soil K availability and K fixation to cotton K response determined in field experiments (1 site in 2001; additional sites in 2002)
4. Distribute map and soil K procedure to the fertilizer and laboratory industries, crop advisers, and cotton growers in the San Joaquin Valley (2002)

Work Description

January – April 2001

We obtained three databases for use on the mapping part of this project:

- Pink Bollworm California Cotton maps from 1999 and 2000 and California Cotton Acreage files for 1998-2000. These files include all cotton acreage in Fresno, Kern, Kings, Madera, Merced, and Tulare counties. The resolution of these maps is about five acres. These were provided to us by Jim Rudig, supervisor of the California Department of Food & Agriculture's Integrated Pest Control Branch, in both MapInfo® and ArcView® GIS formats.
- SSURGO, a USDA-NRCS soils digital database, which contains soils information at the scale of the typical county soil survey;
- STATSGO, a USDA-NRCS soils database that has larger mapping units suitable for multi-county or state maps.

Using MapInfo®, UC Davis soil science graduate student Craig Rasmussen, produced two preliminary maps of the San Joaquin Valley – one based on SSURGO, the other on STATSGO – showing in green the location of land planted or replanted to cotton in at least one year during the 1998-2000 period and additionally showing in red, blue, and yellow (depending on percent of the area within a mapping unit) the locations of soils that are classified at the family

level as (i) coarse loamy or (ii) fine loamy with coarse surface texture. Based on published research, we hypothesize that these two soil families are more likely to contain soils with minerals that fix potassium. These maps show extensive areas of cotton production within the red and blue map polygons, which indicate the presence of the soils hypothesized to have a high potential K-fixing capacity. Copies of the maps are appended to this report and are included in the electronic version as PDF files that can be viewed with Adobe Acrobat® Reader.

Because of the differences in resolution of the two databases and because the mapping units in the two databases were independently developed (e.g., the STATSGO mapping units were not formed by aggregation of SSURGO units), there is general agreement, but not complete agreement between the locations of the selected soil families. The SSURGO database, because it is mapped on a smaller scale will be more accurate at that scale; however, SSURGO coverage is not yet available for all San Joaquin Valley counties, and therefore we are also using STATSGO.

April-June, 2001

1. We developed site selection criteria for soil sampling.
 - a. Sites must be in Kern, Kings, Tulare, or Fresno Co. and must have been in cotton production at least once during the period 1999-2001 or planned for 2002.
 - b. No K fertilizer or animal manure applied from 1999 to the present.
 - c. Soil K test value (ammonium acetate extractable) below 120 mg/kg.
 - d. In Kern, Kings, and Fresno, one site in each of the following soil classification categories is desired: (1) coarse-loamy family or fine-loamy family with coarser surface texture derived from Sierra Nevada-derived parent material; (2) the same but derived from Coast Range parent material. (3) Fine-textured parent material, such as found in lake bottom soils. Tulare Co. being entirely on the east side of the San Joaquin Valley will have only two sites – in the first and second categories.
 - e. Potential for use as a K fertilizer strip trial in 2002 is desired but is not a requirement for the 2001 soil characterization.
2. We have set a rough schedule for soil sampling with UC Cooperative Extension cotton farm advisors. Dr. Pettygrove and graduate student D.G. McGahan, who will lead the field sampling, have met with all four farm advisors – Dan Munk, Bruce Roberts, Steve Wright, and Brian Marsh. Sites and growers are being selected for reconnaissance sampling to take place in mid- to late August by the farm advisors based on location in SSURGO maps. Initial selection is being based on location, on grower willingness to participate, and according to site selection criteria (a), (b), and (d). Criterion (d) is initially determined by reference to SSURGO, then later by examination of control horizon texture. Based on soil K tests conducted in Dr. Southard's laboratory at UC Davis (criterion (c)) -- 11 final sites will be selected for more thorough characterization. Graduate

student Masha Meese and staff research associate Jiayou Deng will assist Mr. McGahan in the detailed sampling in mid- to late September.

3. Field map sheets and the correlation document with soil classifications for western Fresno Co. were obtained from Mr. Kerry Arroues, NRCS, Hanford office. When we began the project in January, we were hampered by lack of an Order 2 soil survey of western Fresno Co., which has not yet been published. We now have the field sheets that will allow us to select sites. The digital electronic form – SSURGO -- has not yet been certified by NRCS, but we expect to have the digital product in the coming year.
4. We established a K fertilizer strip trial at the Gene Nord farm near Kerman in Fresno Co. This will also serve as one of the soil sampling sites from the east side (Sierra) coarse loamy/fine loamy coarse surface textured category. The strip trial is supported by a California Department of Food & Agriculture FREP grant. K fertilizer (0-0-10) was purchased by the FREP grant for the 15-acre trial. Treatments are 0, 150, or 400 lb K₂O/acre knifed into the beds on replicate field-length plots. Each plot is divided with half receiving no foliar K and half receiving foliar K as K₂SO₄. A plot map of this experiment is attached.
5. Laboratory protocols for soil analysis have been established and tested by D.G. McGahan with assistance from a high school intern in the UC Davis National Science Foundation Young Scholars program, Jessica Pechner. Reagents have been obtained for the modified sodium tetraphenyl boron soil test.
6. The P.I.s and graduate students met with Dr. Bob Nichols, Cotton, Inc. in Davis on 6/11/01. This meeting helped us articulate the science behind the project proposal and the rationale for site selection criteria. We expect that soils derived from Sierra Nevadan parent material, particularly those that have significant amounts of their sand and silt fractions derived from biotite mica, will have a high potential for fixing K compared to soils on the west side of the San Joaquin Valley derived from Coast Range parent material. Our rationale here is that the biotite weathers fairly quickly to vermiculite in the coarser fractions. Vermiculite has the potential to trap K in mineral interlayers following K-fertilization and drying of the soil. We expect that soils formed from geologic materials from the Coast Ranges, and fine-textured soils formed from rocks containing biotite, will not contain much vermiculite and will be less likely to fix K.